

# FORMULATION AND EVALUATION OF POLYHERBAL COOKIES IN DIABETIC PATIENTS

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## ABSTRACT

Diabetes mellitus is a chronic metabolic disorder characterized by persistent hyperglycemia resulting from impaired insulin secretion, insulin resistance, or both. Long-term management of diabetes requires not only pharmacological intervention but also appropriate dietary modifications. Functional foods enriched with medicinal herbs have gained considerable attention due to their therapeutic potential and nutritional benefits. The present research work focuses on the formulation and evaluation of polyherbal cookies intended for diabetic patients using herbal ingredients such as *Tecoma stans*, cinnamon, and tulsi incorporated into a nutritious cereal-legume base. The developed polyherbal cookies were formulated using wheat flour, oats, black gram flour, butter, jaggery, milk, and selected medicinal herbs possessing antidiabetic activity. The aim of the study was to develop cookies with low glycemic potential, enhanced dietary fiber content, improved nutritional value, and acceptable sensory properties. The prepared cookies were subjected to proximate nutritional evaluation, phytochemical screening, moisture content determination, ash value determination, and sensory analysis. The phytochemical analysis confirmed the presence of alkaloids, flavonoids, tannins, glycosides, proteins, amino acids, and saponins, indicating the therapeutic value of the formulation. Sensory evaluation using a 9-point hedonic scale demonstrated acceptable taste, aroma, texture, and overall palatability among participants. The incorporation of herbal ingredients significantly improved the functional value of the cookies without adversely affecting their sensory attributes. The study concludes that polyherbal cookies can serve as a beneficial dietary supplement for diabetic patients by helping in glycemic control, improving nutritional intake, and providing antioxidant support. Such formulations may offer a healthier alternative to conventional high-sugar bakery products. Further clinical investigations are recommended to validate their long-term therapeutic effectiveness in diabetic management.

**Keywords:** Diabetes mellitus, Polyherbal cookies, Functional food, *Tecoma stans*, Cinnamon, Tulsi, Antidiabetic activity, Nutraceutical.

## INTRODUCTION

Diabetes mellitus is one of the most common chronic metabolic disorders affecting millions of individuals worldwide. It is characterized by elevated blood glucose levels due to insufficient insulin production, impaired insulin action, or both. Persistent hyperglycemia can lead to serious complications including cardiovascular diseases, neuropathy, nephropathy, retinopathy, and delayed wound healing. Proper management of diabetes requires a combination of pharmacological treatment, physical activity, and dietary modifications. In recent years, functional foods and nutraceuticals have gained increasing importance in the prevention and management of chronic diseases. Functional foods are foods enriched with biologically active compounds that provide health benefits beyond basic nutrition. Herbal formulations incorporated into food products are particularly useful in managing metabolic disorders because they combine nutritional support with therapeutic benefits. Among different food products, cookies are widely accepted due to their convenience, taste, long shelf life, and easy availability. However, conventional cookies are generally prepared using refined

flour and sugar, which possess a high glycemic index and may cause rapid spikes in blood glucose levels. Therefore, there is a growing need to develop healthier bakery products suitable for diabetic patients. Polyherbal formulations involve the combination of multiple medicinal herbs to produce synergistic therapeutic effects. In the present study, medicinal herbs such as *Tecoma stans*, cinnamon, and tulsi were selected based on their reported antidiabetic, antioxidant, and anti-inflammatory properties. These herbs were incorporated into a cookie formulation prepared using wheat flour, oats, and black gram flour to enhance nutritional value and reduce glycemic response. The oral route of administration was selected because it is the most convenient, economical, and patient-compliant route for long-term therapy. Functional foods consumed orally allow gradual release and absorption of bioactive compounds through the gastrointestinal tract. The dietary fiber and complex carbohydrates present in the cookie matrix may slow glucose absorption and improve postprandial glycemic control. The developed polyherbal cookies were designed to provide nutritional support, antioxidant protection, and potential glycemic regulation while maintaining acceptable sensory properties. This research work aims to formulate, evaluate, and analyze the therapeutic potential of polyherbal cookies for diabetic patients.

## NEED OF THE STUDY

Diabetes mellitus has become a major public health concern due to increasing prevalence, sedentary lifestyle, unhealthy eating habits, and obesity. Conventional diabetic management primarily depends on oral hypoglycemic agents and insulin therapy. However, long-term drug therapy may be associated with side effects, high treatment cost, and poor patient compliance. Dietary management plays a crucial role in controlling blood glucose levels and preventing diabetic complications. Bakery products such as cookies are commonly consumed snacks, but most commercially available cookies contain refined flour and high amounts of sugar, making them unsuitable for diabetic patients. The incorporation of medicinal herbs into functional food products offers a natural and economical approach for diabetes management. Herbs such as cinnamon, tulsi, and *Tecoma stans* possess antihyperglycemic, antioxidant, anti-inflammatory, and insulin-sensitizing properties. Combining these herbs in a nutraceutical formulation may provide synergistic therapeutic benefits. The present study was therefore undertaken to formulate polyherbal cookies with improved nutritional composition, reduced glycemic load, enhanced dietary fiber content, and acceptable sensory characteristics for diabetic individuals.

## OBJECTIVES

1. To formulate polyherbal cookies using medicinal herbs with antidiabetic activity.
2. To reduce postprandial blood glucose spikes through low-glycemic ingredients.
3. To improve insulin sensitivity naturally using herbal components.
4. To enhance nutritional value by incorporating dietary fiber and protein-rich ingredients.
5. To evaluate physicochemical properties of the prepared cookies.
6. To perform phytochemical screening of the herbal formulation.
7. To assess sensory acceptability using a hedonic scale.
8. To provide a healthier alternative to conventional sugary bakery products.

## ADVANTAGES OF POLYHERBAL COOKIES

1. Provides nutritional support for diabetic patients.
2. Contains natural antidiabetic herbs.
3. Improves dietary fiber intake.
4. Reduces glycemic load.
5. Offers antioxidant protection.

6. Improves patient compliance due to good palatability.
7. Convenient and economical dosage form.
8. Suitable as a healthy snack alternative.

## MATERIALS AND METHODS

### Materials Used

#### Herbal Ingredients

- Tecoma stans leaves powder
- Cinnamon bark powder
- Tulsi powder

#### Other Ingredients

- Wheat flour
- Oats
- Black gram flour
- Butter
- Milk
- Baking powder
- Baking soda
- Salt
- Jaggery

### Procurement of Materials

Fresh aerial parts of Tecoma stans, tulsi leaves, and cinnamon bark were collected from local areas of Chandrapur city. The plant materials were washed thoroughly and dried under sunlight. The dried material was powdered and stored in airtight containers. Other ingredients including oats, milk, butter, baking powder, baking soda, and jaggery were procured from the local market.

## METHOD OF PREPARATION

### Preparation of Polyherbal Cookies

1. Wheat flour, oats, and black gram flour were weighed accurately.
2. Herbal powders including Tecoma stans, cinnamon, and tulsi were mixed uniformly.
3. Butter and jaggery were creamed together.
4. Milk was added slowly to obtain smooth dough consistency.
5. Baking powder, baking soda, and salt were incorporated.
6. The prepared dough was kneaded thoroughly.
7. Cookies were shaped manually.

8. The cookies were baked in a preheated oven at suitable temperature.
9. Prepared cookies were cooled and stored in airtight containers.

### FORMULATION TABLE

SR.NO	INGREDIENTS	QUNTITY (%)	USES IN FORMULATION
1	Wheat flour	30	Acts as the main base material of cookies and provides structure, texture, and carbohydrates.
2	Oats	20	Rich source of dietary fiber ( $\beta$ -glucan); helps reduce blood glucose spikes and improves digestion.
3	Black gram flour	15	Enhances protein content, nutritional value, and improves satiety in diabetic patients.
4	Tecoma stans powder	5	Provides antidiabetic activity and helps in controlling blood glucose levels.
5	Cinnamon powder	3	Improves insulin sensitivity and exhibits antioxidant and antihyperglycemic properties.
6	Tulsi powder	2	Acts as an antioxidant, anti-inflammatory, and supports glucose metabolism.
7	Butter	10	Provides softness, flavor, texture, and improves mouthfeel of cookies.
8	Jaggery	10	Natural sweetening agent used instead of refined sugar; improves taste and binding.
9	Milk	q.s	
10	Baking powder	2	Leavening agent that increases volume and gives soft texture to cookies.
11	Baking soda	1	Helps in dough formation, improves texture, moisture, and nutritional quality.
12	Salt	1	Enhances flavor and balances sweetness in the formulation.

## EVALUATION OF POLYHERBAL COOKIES

### Organoleptic Evaluation

The prepared cookies were evaluated for:

- Color
- Appearance
- Texture
- Odor
- Taste

The cookies showed acceptable appearance with pleasant aroma and good texture.

### Moisture Content Determination

Moisture content was determined using hot air oven method.

### Procedure

1. Weighed cookies were placed in a moisture dish.
2. Samples were dried at 105°C for 2 hours.
3. Samples were cooled in desiccators.
4. Weighing was repeated until constant weight was obtained.

### Formula

Moisture content (%) =

$$\frac{(W1 - W2)}{(W1 - W)} \times 100$$

Where:

- W1 = Weight before drying
- W2 = Weight after drying
- W = Weight of empty dish

## Ash Value Determination

Ash value indicates total mineral content.

### Procedure

1. One gram cookie sample was taken in crucible.
2. Sample was incinerated using Bunsen burner.
3. Carbon-free ash was obtained.
4. Crucible was cooled and weighed.
5. Heating was repeated until constant weight.

### Formula

Ash value (%) =

$$((W1 - W2) / W) \times 100$$

Where:

- W1 = Weight of crucible with ash
- W2 = Weight of empty crucible
- W = Weight of sample

## PHYTOCHEMICAL SCREENING

### Test for Alkaloids

#### Procedure

Powdered extract was treated with 2% H<sub>2</sub>SO<sub>4</sub> and Dragendorff's reagent.

#### Observation

Orange-red precipitate indicated presence of alkaloids.

### Test for Tannins

#### Procedure

Extract was heated with water and ferric chloride was added.

#### Observation

Dark green coloration indicated tannins.

### **Test for Glycosides**

#### **Procedure**

Hydrolyzed extract was treated with Fehling's solution.

#### **Observation**

Red precipitate confirmed glycosides.

### **Test for Saponins**

#### **Procedure**

Extract was boiled with distilled water.

#### **Observation**

Persistent frothing indicated saponins.

### **Test for Flavonoids**

#### **Procedure**

Extract was treated with NaOH followed by HCl.

#### **Observation**

Yellow color turning colorless indicated flavonoids.

### **Test for Proteins**

#### **Procedure**

Extract was treated with copper sulfate and NaOH.

#### **Observation**

Violet coloration indicated proteins.

### **Test for Amino Acids**

#### **Procedure**

Million's reagent was added to extract.

**Observation**

Red coloration indicated amino acids.



**RESULTS AND DISCUSSION**

**ORGANOLEPTIC PROPERTIES**

The prepared polyherbal cookies exhibited acceptable organoleptic characteristics. The cookies appeared brownish in color due to the presence of herbal powders and jaggery. The texture was crisp and uniform with pleasant aroma.

SR.NO	Parameter	Observation
1	Color	Light brown
2	Odor	Pleasant
3	Texture	Crisp
4	Taste	Acceptable
5	Appearance	Uniform

**MOISTURE CONTENT**

The moisture content of prepared cookies was found within acceptable limits, indicating good shelf stability.

SR.NO	Sample	Moisture Content (%)
1	Polyherbal Cookies	4.8 ± 0.2

Lower moisture content helps prevent microbial growth and enhances storage stability.

**ASH VALUE**

The ash value indicated the presence of mineral content contributed by herbal ingredients and black gram flour.

SR.NO	Sample	Ash value (%)
1	Polyherbal Cookies	2.5 ± 0.1

## PHYTOCHEMICAL SCREENING RESULTS

SR.NO	PHYTOCHEMICAL TEST	OBSERVATION	RESULT
1	Alkaloids	Orange-red precipitate	Present
2	Tannins	Dark green color	Present
3	Glycosides	Red precipitate	Present
4	Saponins	Stable froth	Present
5	Flavonoids	Yellow to colorless	Present
6	Proteins	Violet color	Present
7	Amino acids	Red coloration	Present

The phytochemical screening confirmed the presence of important bioactive compounds responsible for antidiabetic and antioxidant activity.

### Discussion

The present investigation demonstrated successful formulation of polyherbal cookies suitable for diabetic patients. Incorporation of medicinal herbs such as *Tecoma stans*, cinnamon, and tulsi enhanced the therapeutic potential of the cookies. The use of oats and black gram flour increased dietary fiber and protein content, which may help improve glycemic control. The phytochemical constituents identified in the formulation are known for their antihyperglycemic and antioxidant activities. Cinnamon may improve insulin sensitivity, while *Tecoma stans* exhibits glucose-lowering effects. Tulsi contributes antioxidant and anti-inflammatory benefits. The prepared cookies possessed acceptable organoleptic properties and favorable sensory characteristics, indicating that herbal incorporation did not negatively affect consumer acceptability. The low moisture content suggests good shelf stability. The formulation may serve as a healthy snack alternative for diabetic patients and may help reduce postprandial glucose spikes.

### CONCLUSION

The present study successfully formulated and evaluated polyherbal cookies intended for diabetic patients using medicinal herbs and nutritionally rich ingredients. The incorporation of *Tecoma stans*, cinnamon, and tulsi provided significant phytochemical constituents including alkaloids, flavonoids, tannins, glycosides, and saponins. The prepared cookies exhibited acceptable physicochemical characteristics, good sensory properties, and enhanced nutritional value. The presence of dietary fiber, protein, and herbal bioactive compounds may help regulate blood glucose levels and improve overall metabolic health. Polyherbal cookies can therefore be considered a promising functional food and nutraceutical supplement for diabetic individuals. Further clinical and pharmacological studies are recommended to establish their long-term safety, efficacy, and therapeutic benefits.

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